

PATENT SPECIFICATION

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(54) HYDROPHILIC POLYESTER FILAMENTS

(71) We, BAYER AKTIENGESELLSCHAFT, a body corporate organised under the laws of the Federal Republic of Germany of 509 Leverkusen, Germany and FASERWERKE HÜLS GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a body corporate organised under the laws of the Federal Republic of Germany of Marl, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to the production of melt-spun polyester filaments and fibres and more particularly to the production of polyester filaments and fibres having improved water-retention capacity.

The production of filaments and fibres of linear filament-forming polyester has long been known. To this end, dicarboxylic acids are reacted with diols to form high molecular weight linear polyesters which are subsequently spun.

The filaments produced from polyesters such as these by the melt-spinning process are normally tied into bundles, drawn in hot water or another medium, heat set in hot air, crimped and cut into staple fibres. Fibres such as these have on average a strength of from 2.5 to 4.5 p/dtex, an elongation of from 20 to 50% and a boiling-induced shrinkage of from 0 to 3%. They can be processed into textiles with excellent wearing properties, such as high resistance to creasing, high strength and high scuff resistance.

Unfortunately, polyester filaments and fibres of the kind in question are attended by the disadvantage that they have only a limited water-retention capacity and, therefore, tend to develop an electrostatic charge which makes them extremely uncomfortable to wear. For example, filaments of polyethylene terephthalate

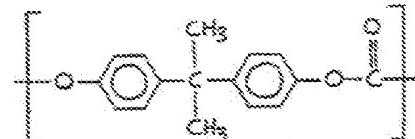
have a water retention capacity under standard climatic conditions of only 5%, as measured on a piece of knitting. Attempts to improve the low water retention capacity i.e. to reduce the tendency towards electrostatic charging, for example by applying a preparation during spinning or by suitably finishing the sheet-form textile frequently have an adverse effect upon the feel or wearing properties of the textile.

We have, therefore, sought to provide a process for the production of polyester filaments and fibers with improved water-retention capacity.

Thus, we have now found a process for the production of melt-spun polyester filaments and fibres having improved water-retention capacity, wherein from 3 to 20% by weight of a polycarbonate, based on the total mixture, is added to a polyester to be spun and wherein the mixture thus obtained is subsequently melt-spun into filaments.

The polyester may be any filament-forming polyester of the type known in this art. It is preferred to use polyesters containing terephthalic acid, isophthalic acid and hexahydroterephthalic acid as the dicarboxylic acid component and ethylene glycol, 1,4-butane diol, 1,3-propane diol or 1,4-bis(hydroxymethyl)-cyclohexane as the glycol component. Polyethylene terephthalate is preferably used.

The preferred polycarbonate, which is preferably used in a quantity of from 3 to 15% by weight, comprises repeating units of the general formula:



The relative solution viscosity  $\eta_{sp}$  of the polycarbonate as measured in a 0.5%

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solution in methylene chloride at 20°C should amount to between 1.10 and 1.25 (corresponding to intrinsic viscosity ( $\eta_{inh}$ ) 0.15 to 0.45) and preferably to between 1.18 and 1.23 (corresponding to  $\eta_{inh}$  0.33 to 0.42).

The polycarbonate is spun into the polyester by mixing the thoroughly dried granulates and delivering them together to an extruder where they are melted at temperatures of from 260°C to 300°C and, after a residence time of from 3 to 12 minutes, are melt-spun into fibres or filaments. A dynamic or static mixer is best installed between the extruder and the orifice in order to obtain better admixture of the two polymers.

The extrusion process is accompanied by a transesterification reaction between the polyester and the polycarbonate during which *inter alia* gaseous carbon dioxide is formed. Accordingly, the extruder should be operated so that the CO<sub>2</sub> remains dissolved under high pressure in the polymer mixture and only escapes when the melt issues from the orifice and expands, vacuoles being left behind in the filament. At high take-off rates of around 1000 m/min, these vacuoles are aligned in the longitudinal direction of the filament below the orifice in that part of the melt which is still plastic.

The conditions are right for spinning the mixture when the temperature of the extruder is maintained at a lower temperature than, for example, in the spinning of pure polyethylene terephthalate. The temperature range from 275°C to 280°C has proved to be very favourable for the polymer mixture whereas, in the case of pure polyethylene terephthalate, an extruder temperature of from 290°C to 295°C is normally adjusted.

In addition, the residence time of the polymer mixture in the extruder has to be selected in dependence upon the amount of polycarbonate added, i.e. where relatively large quantities of polycarbonate, for example from 8 to 20%, are added, the residence time should be relatively short, that is between 3 and 6 minutes, to ensure that not too much CO<sub>2</sub> is formed and that no bubbles are formed which would give rise to filament breakages. Where relatively small quantities of polycarbonate, for example from 3 to 8%, are added, the residence time may be correspondingly longer, amounting to between 6 and 12 minutes. Under these conditions, the CO<sub>2</sub> formed remains in solution in the polymer mixture which is under high pressure.

The pressure on the mount amounts on average to between 80 and 250 bars.

After spinning, the filaments are bundled to form a tow, the tow thus formed is drawn,

preferably to three to four times its original length, in a water bath heated to around 60°—95°C and, optionally, after-drawn to a slight extent in a steam duct at a temperature of from 140°C to 190°C. The tow may then be crimped in a crimping chamber. Thereafter it is dried, brightened and optionally cut into staple fibres.

The fibres produced in this way show vacuoles which have a diameter of from 0.1 to 100  $\mu\text{m}$ , preferably from 0.5 to 10  $\mu\text{m}$ , and a length of from 2 to 400  $\mu\text{m}$ , preferably from 5 to 100  $\mu\text{m}$ . Water may enter these vacuoles. This gives a water-retention capacity of from 6 to 30%, preferably from 7 to 23%, as measured on a piece of knitting in accordance with DIN 53814.

The relative solution viscosity  $\eta_{sp}$  of the polycarbonate quoted in the description and Examples is the ratio of a 0.5% solution of the polycarbonate in methylene chloride to the viscosity of the pure methylene chloride, as measured in the same units at 30°C in an Ubbelohde viscosimeter.

The following Examples further illustrate the invention. Parts specified represent parts by weight.

### EXAMPLE

10 parts of bisphenol A-polycarbonate granulate having an  $\eta_m$ -value of 1.23 were thoroughly mixed with 90 parts of polyethylene terephthalate granulate, dried and delivered to an extruder. The granulates were melted at a temperature of 277°C., extruded after a residence time of 5 minutes, spun into filaments and wound into package form at a rate of 1100 m/min. The extruder pressure was 110 bars.

Several filaments were doubled to form a tow, drawn to 3.5 times their original length in a water bath heated to 81°C, after-drawn in a ratio of 1:1.12 in a steaming duct at 160°C, crimped, dried, brightened and then cut into 60 mm long staple fibres. The fibres had the following properties:

denier: 6.7 dtex  
strength: 3.5 cN/dtex  
elongation: 30%

The water-retention capacity of the fibres was measured after boiling in accordance with DIN 53814. It amounted to 18% at 20°C/65% relative humidity.

### EXAMPLE 3

13 parts of bisphenol A-polycarbonate granulate having an  $\eta_{sp}$ -value of 1.21 were thoroughly mixed with 87 parts of polyethylene terephthalate granulate, dried and then delivered to an extruder. The granulates were melted at a temperature of 276°C., extruded into filaments after a residence time of 4.5 minutes and wound

into package form at a rate of 1100 m/min. The extruder pressure was 120 bars.

Several filaments were doubled to form a tow, drawn to 3.5 times their original length in a water bath heated to 81°C, after-drawn in a ratio of 1:1.12 in a steaming duct at 160°C, crimped, dried, brightened and then cut into 60 mm long staple fibres. The fibres had the following properties:

10	denier;	6.7 dtex
	strength;	3.4 cN/dtex
	elongation;	31%

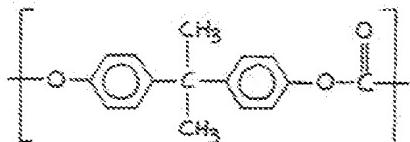
The water-retention capacity of the fibres was measured after boiling in accordance with DIN 53814. It amounted to 18% at 20°C/65% relative humidity.

## **WHAT WE CLAIM IS:—**

1. A process for the production of melt-spun polyester filaments and fibres having improved water retention capacity, wherein from 3 to 20% by weight of a polycarbonate, based on the total mixture, is added to a polyester to be spun and wherein the mixture thus obtained is subsequently melt-spun into filaments.

2. A process as claimed in Claim 1, wherein the polycarbonate is added in a quantity of 5 to 15% by weight based on the total mixture.

30 3. A process as claimed in Claim 1 or 2, wherein the polycarbonate comprises repeating structural units of the formula:



4. A process as claimed in any of Claims 1 to 3, wherein the polycarbonate has a relative solution viscosity of between 1.10 and 1.25, as measured in a 0.5% solution in methylene chloride at 20°C.

5. A process as claimed in Claim 4, wherein the polycarbonate has a relative solution viscosity of between 1.18 and 1.23, as measured in a 0.5% solution in methylene chloride at 20°C.

6. A process as claimed in any of Claims 1 to 4, wherein the polyester is polyethylene terephthalate. 43

7. A process as claimed in any of Claims 1 to 6, wherein the polycarbonate is mixed with the polyester and the mixture is melted at a temperature of from 260°C to 300°C and wherein after a residence time of from 3 to 12 minutes the mixture is melt-spun into fibres or filaments.

8. A process for the production of polyester filaments and fibres substantially as herein described with reference to either of the specific Examples.

9. Melt-spun polyester filaments and fibres having improved water retention capacity when prepared by a process as claimed in any of Claims 1 to 8.

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